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The acceptability of and symptom findings from an online symptom check-in tool for COVID-19 outpatient follow-up.

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Competing Interest Statement

"All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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The subject matter of this paper was conceived by CK, SOR and CB, and designed by CK, SOR, GH, DC with oversight from UG and NN. All parties contributed to the editing of this paper. CK is the lead author and guarantor of this paper.

Transparency declaration

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Details of ethical approval

Full ethical approval was granted for this research by the St. James's Hospital and Tallaght University Hospital ethics committee on 31/3/20 (REC: 2020-03 Chairman's Action (16)).

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Patients and the public were not involved in any way with the design of this research.

Data Sharing

All authors agree to sharing of the data contained in this research.

Abstract

Introduction

Health systems worldwide have had to make preparations for a surge in volume in both the outpatient and inpatient settings since the emergence of COVID-19. International healthcare experiences show approximately 80% of patients classed as having mild disease that can be managed as outpatients. However, SARS-CoV-2 can cause a biphasic illness. Those affected experience a clinical deterioration usually seen between day 4 and day 9 of their illness.

Aim

Our aim was to create an online tool to allow for virtual disease triage, to promote patient education and gather information on patient symptomatology.

Methods

Outpatients with acute COVID-19 disease diagnosed at the hospital received text messages from the hospital containing a link to an online symptom check-in tool.

Results

296 unique participants (72%) from 413 contacted by text completed the online check-in at least once. Participants found the tool to be useful and easy to use, describing it as “helpful” and “reassuring” in a follow-up feedback survey (n=140). 93% said they would use such a tool in the future. Fatigue was the most common symptom reported (79%), followed by headache (72%) overall. Fatigue, headache and myalgia were the most frequently reported symptoms in the first 3 days of illness. 8% of participants did not report any of the cardinal symptoms (fever, cough, dyspnoea, taste/smell disturbance) in the first 7 days of their illness. 39% reported ongoing fatigue, 16% reported ongoing smell disturbance and 14% reported ongoing dyspnoea after 6 months.

Conclusion

This online symptom check-in tool was found to be acceptable to patients and saw high levels of engagement and satisfaction. The findings highlight the variety and persistence of symptoms experienced. It also lends weight to the debate on the expansion of test criteria for COVID-19.

Strengths and Limitations

Strengths

- High level of uptake among of the tool among those contacted (72%), resulting in over 800 responses from almost 300 unique individuals during wave 1.
- This research also features a 6 month follow-up from this cohort.

Weaknesses

- Tool requires smartphone internet access to complete the tool which may disadvantage older users
- Requires a baseline level of technology literacy.
- The online system at present only exists in English

Introduction

The COVID-19 pandemic poses a major obstacle to healthcare services across the globe. Originating in Wuhan, China, in late 2019 (1), the World Health Organisation declared the outbreak to be a Public Health Emergency of International Concern on January 30th 2020 (2) and a pandemic on March 11th 2020 (3). As of February 1st 2021, there have been over 100 million confirmed cases of the infection worldwide with over 2 million deaths (4). International healthcare experiences of COVID-19 infections show that approximately 20% of known patients with COVID-19 require inpatient admission (5-9). This in turn means that approximately 80% of patients' diagnoses are classed as having mild disease and can be managed as outpatients.

SARS-CoV-2 however can cause a biphasic illness in some patients (10). Those affected can experience a clinical deterioration usually seen between day 4 and day 9 of their illness and attributed to a form of cytokine storm (6, 11). This can result in a worsening of the disease course for community-based patients with COVID-19, initially having been well enough not to require inpatient care, leading to the need for clinical assessment and possible hospital admission. In particular, approximately 50% of patients with COVID-19 can develop shortness of breath or breathing difficulties (12) which can be indicative of more serious disease that may require hospitalisation.

Health systems worldwide have had to make preparations for a surge in volume in both the outpatient and inpatient settings since the emergence of COVID-19 (13). This increased demand on clinical capacity created several health system challenges as described and discussed by Judson et al. (14). Firstly, provision of care to the patients who needed it most was made more difficult by front-line clinicians and healthcare staff spending a large proportion of their time on triage. Secondly, a surge of patients attending urgent care and primary care practices for advice placed a further burden on healthcare systems as well as potentially impacting on infection control management. Thirdly, constantly changing information and guidelines placed a strain on maintaining consistency in terms of medical recommendations.

Aim

Our primary aim was to create an online tool to allow disease triage of outpatients diagnosed with COVID-19 at the hospital. The text and online tool would contain the phone number for the hospital's clinician-led COVID-19 phone line. Outpatients were prompted to contact this phone number if they had any clinical concerns related to their acute illness. Outpatients reporting worsening symptoms of clinical concern would be triaged, identified and contacted by the hospital's COVID-19 outpatient team. The tool also aimed to promote patient education by providing a weblink to national COVID-19 related health information sources that the patient could access if they so wished.

A secondary aim of this tool was to collect information on patient demographics and the range and duration of symptoms they experienced during the acute phase of their COVID-19 illness.

Methods

The online Typeform (™) platform was used to create a short online tool (COVID-19 symptom check-in tool) to provide information to and help triage outpatients with acute COVID-19 diagnosed at St. James's Hospital.

Text messages were sent from the hospital to outpatients at day 3, day 6, day 9 and day 12 of their illness, covering the biphasic timeline of the illness in most cases. These dates were automatically calculated by using the patient's date of symptom onset, recorded on their electronic personal health record, as day 1. The text contained a link to the online symptom check-in tool as well as a brief explanation of its purpose and the contact phone number for the dedicated clinician-led COVID-19 phone line that they could call if COVID-19 related advice was required. The questions in the tool were arrived at by clinician consensus and adapted from the publications below which became available during the design period.

The tool (supplementary material) consisted of 13 questions capturing basic patient information such as risk factors (adapted from Wu et al (15)), duration and nature of COVID-19 symptoms (adapted from Chen et al (16)), temperature and pulse oximetry (17) readings in the past 24 hours (if available), as well as an overall self-assessment of symptom progression since symptom onset. Two questions to assess the presence and severity of any breathing symptoms were adapted from the Greenhalgh et al. publication on remote clinical assessment of patients with COVID-19 (18). A short introductory and a conclusion page provided information on the hospital data privacy policy, a web link to the official national health service website for COVID-19 information (in multiple languages) as well as the contact phone number for the dedicated clinician-led COVID-19 phone line and the contact number for the emergency services should they be in extremis.

A clinician reviewed each response to the tool and made calls to outpatients if deemed necessary, taking into account the patient's reported symptoms, duration of illness, severity of symptoms and past medical history. If a response led to clinical suspicion of patient deterioration in the community, the patient would be contacted and assessed by the clinician over the telephone and a decision made to either reassure the patient and continue to monitor symptoms at home, link the patient in to further support services (home pulse oximetry), arrange a medical assessment at the hospital or advise to contact the emergency services and present immediately to the emergency department.

A follow-up survey was sent 6 months later to all recipients of the initial text messages to assess for feedback on their experience of the service. These findings are included in this paper.

Results

From April 2nd to June 7th, 1324 text messages were sent to 413 COVID-19 positive outpatients who had been diagnosed at St. James's Hospital, Dublin. These text messages led to 831 responses (62.8% response rate) on the online COVID-19 symptom check-in. The average age of the 413 text recipients was 41 years (median 39 years), with ages ranging from 19 – 99 years. 129 (31%) were male with 284 (69%) female. 342 (83%) were healthcare workers. 296 unique participants (72%) from the 413 contacted by text completed the online check-in at least once. The average age of these 296 patients was 37 years (median 35 years), with ages ranging from 19 – 81 years. 80 (27%) were male with 216 (73%) female. 269 of the respondents (90%) were healthcare workers.

Of the 117 (28%) who declined to respond to the online symptom check-in tool, the average age was 51 years (median age 51), with ages ranging from 21 – 99 years. 48 (41%) were male and 69 (59%) female. 76 (65%) were healthcare workers. Using Wilcoxon Rank Sum test (Mann-Whitney test), there was a statistically significant difference in the ages of participants who used the online symptom check-in tool versus those who didn't, with older patients less likely to participate than younger patients ($p < 0.01$). Using chi square testing, there was also a statistically significant difference among the genders ($p<0.01$) and healthcare worker status ($p<0.01$) in relation to their participation in the online symptom check-in tool with males and non-healthcare workers less likely to participate.

A feedback survey, to evaluate acceptability of the online check-in, was sent to the original 413 patients 6 months later in December 2020. This survey received 140 responses (34%). 32 (23%) were male and 108 (67%) were female. 116 (83%) were healthcare workers. The age categories of these participants were recorded and can be viewed in figure 1.

Online check-in tool

21 (7%) of online check-in participants had already spent at least one night in hospital due to COVID-19. 41 (17%) were current or ex-smokers. 59 (20%) didn't have access to thermometers and 225 (76%) had not been advised to use pulse oximeters at home. The comorbidities of the cohort are shown in table 1 below. Thirty-three (11%) of participants had a history of asthma or COPD, with 20 (7%) having hypertension and 11 (4%) having a diagnosis of diabetes (table 1).

Comorbidities	n (total n=296)	% of total respondents
COPD/Asthma	33	11
Hypertension	20	7
Diabetes mellitus	11	4
Other endocrinopathies	9	3
Ischaemic heart disease	4	1
Immunosuppression	3	1
Haematological disorder	2	1
Active cancer diagnosis	2	1
Neurological disorder	1	0
Chronic kidney disease	1	0
Chronic liver disease	0	0

Table 1. Comorbidities of those who participated in the online COVID-19 symptom check-in.

Figure 2 shows the symptoms reported by the 296 participants over time. There were 831 responses in total to the online COVID symptom check-in, with 85 from participants from Day 0-4 of their onset of symptoms, 235 responses during days 5-8, 253 responses during days 9-12, 165 responses during days 13-16 and 93 responses from patients from 17-48 days after the onset of their symptoms. Fatigue was the most common symptom in the first 4 days of illness, followed by headache and myalgia. The case criteria symptoms of cough, taste & smell disturbance, pyrexia and cough were the 4th, 5th, 6th, 16th and 19th most frequently reported symptoms respectively during this period.

Most symptoms remained static or decreased over time with the exception of taste, smell disturbance and anorexia which peaked during days 5-8 of symptoms. Only 25% of participants reported full resolution of their symptoms at 16 days or more post symptom onset.

Interestingly, 8% of responses (22/259) did not report any of the case defining criteria symptoms during their first 7 days of symptoms. 73% (16/22) of these participants reported fatigue, 55% (12/22) reported headache, 45% (10/22) reported myalgia, 41% (9/22) reported nasal congestion and 36% (8/22) reported pharyngitis. 86% (19/22) of these responses reported a combination of headache, pharyngitis, nasal congestion and coryzal symptoms.

Figure 3 shows the range and frequency of symptoms reported by participants during their initial illness between day 0 and day 48 (n=296) as well as the symptoms reported by participants of the feedback survey 6 months later (n=140). Fatigue was the most common symptom during the initial illness (79%), followed by headache (72%). The symptoms that meet the case definition criteria for COVID-19 (Cough, taste disturbance, smell disturbance, pyrexia and dyspnoea) were the 3rd, 5th, 6th 7th and 13th most frequent symptoms at 66%, 59%, 58%, 49% and 31% respectively. After 6 months, only 39% of participants reported being symptom free. 39% reported ongoing fatigue, 16% reported ongoing smell disturbance and 14% reported ongoing dysnpnoea.

Feedback Survey:

140 participants responded to the feedback survey in December 2020. 79% (111) were third-level educated. 61% (86) were diagnosed with COVID-19 in April 2020, 31% (43) in March and 8% (11) in May. 16% (23) of respondents to this feedback survey were admitted to hospital during their illness. Figure 4 also shows that 79% (111) of participants did not feel inconvenienced by receiving text messages from the hospital, and 77% (108) used the online COVID symptom check in at least once. 53% (74) called the COVID-19 phone line during the course of their illness (this was the phone number contained in the text from the hospital and also highlighted in the online check-in tool). 21% (29) received a pulse oximeter from the hospital for remote SpO2 monitoring.

Participants were asked to choose as many words as applicable from the list in figure 5 to describe the effect that receiving texts from the hospital had on them. “Reassuring”, “useful” and “helpful” were selected in 66%, 56% and 55% of responses, with “distracting”, “worrying” and “unhelpful” each mentioned in 1% of responses (figure 5).

Of those who used the online symptom check-in (n=108), figure 6 shows that 87% (94) used it each time they received a text from the hospital. Only 56% (61) knew that the online symptom check in contained links to official Health Service Executive (Ireland’s national public health service) COVID-19 information. 69% (75) of participants received a call from the COVID-19 team during the course of

their illness. Of these participants (n=75), all but one participant found it helpful to receive such a call. These calls were made to "check-in" with patients if they complained of worsening symptoms or shortness of breath on the symptom check-in tool and assess their need for further clinical evaluation.

Participants were also asked to rate, on a scale of 1-10, how useful, easy to use and satisfied they were with different aspects of the service, along with their perception of the overall quality of the service (figure 7). On average, participants rated the usefulness of receiving a text with the COVID-19 phoneline number (n=140) and links to official COVID-19 info (n=61) at 8.5 and 8.1 respectively, their satisfaction with the advice they received on calling the phone line (n=74) at 8.7 and at 8.8 for those who received a call from the COVID team (n=75), and the ease of use of the pulse oximeter (n=28) and the online symptom checker (n=108) at 9.4 and 8.7 respectively. The quality of the service overall was rated as 8.5 (n=108). Of those who used the online symptom check-in (n=108), 93% (100/108) would use such a service again, with 3% saying they wouldn't and 4% saying they were unsure. Reasons given by those who didn't use the online symptom check-in (n=32) included feeling too unwell to use it, forgetting about it, feeling sufficiently informed by healthcare staff already and feeling better and therefore not having a need to use it.

Discussion

This online symptom check-in served several purposes. It made available to outpatients the phone number of the dedicated, clinician-manned in-hospital COVID-19 patient advice phone that the patient was advised to call if they had any COVID-19 related concerns. The tool helped to highlight to patients the red flag symptom of increasing breathlessness at rest associated with severe disease and prompted the patient to contact the hospital or emergency services in the event they experienced these symptoms. The tool provided a weblink to online, national COVID-19 related health information sources that the patient could access if they so wished, something which is ever more important in the era of social media disinformation and "Fake News" (19). This was intended to promote patient engagement and education on COVID-19. However, only 56% those who used the online check-in tool were aware of this weblink to official information, and though those who were aware of this link found it useful, giving it a rating of 8.1 out of 10 in terms of usefulness, more could be done to highlight this weblink in the future.

The tool also allowed for outpatients to be monitored remotely by the COVID medical team via their responses to the online symptom check-in tool. Clinicians could identify patients that required further clinical follow-up via the breadth and severity of symptoms, demographics, comorbidities, reported by the patient. Patients identified as having a need for further follow-up were contacted to assess their clinical needs. Such patients were either managed over the phone, offered home pulse oximetry monitoring, invited for in-hospital assessment or advised to present immediately to the emergency department, as appropriate.

Overall, the system had high levels of uptake with 296 patients out of 413 contacted via text (72%) completing the online symptom check-in at least once during their illness. A large number of healthcare workers at the hospital were diagnosed with COVID-19 between March and June 2020 and this is reflected in the responses to the tool. The large proportion of third level educated participants also likely reflects the participation of healthcare workers. Participants found the service to be easy to use and useful, and the programme intervention was well received with high levels of

satisfaction both from those who called the COVID-19 phoneline for advice and telephone assessment and from those who received calls from the COVID-19 team for advice and telephone assessment after their online symptom check-in responses were flagged. The overall quality of the service was found to be high among users and 93% said they would use such a service again in the future.

Another interesting outcome from this online symptom check-in tool relates to the findings in terms of frequency, range and onset of different symptoms among this cohort of COVID-19 positive patients. Headache, fatigue and myalgia were the most frequently reported symptoms in the initial days of illness, none of which currently belong to the case defining symptoms (fever, cough, dyspnoea, smell/taste disturbance) used by the ECDC (20). Fatigue and headache were reported more frequently overall than other symptoms. Two of the cardinal symptoms, taste and smell disturbance, appear to peak between days 5 and 8 post symptom onset. This could have a negative effect on disease spread if testing is delayed until these symptoms are experienced. A significant number of responses reported nasal congestion (~1/3) and pharyngitis (~1/4) in their initial days of illness. The fact that almost 10% of patients did not experience any of the case defining criteria symptoms of COVID-19 in the first 7 days of their symptoms lends further weight to the case for screening people at high risk of COVID-19 disease. Given their prevalence, especially in comparison to the cardinal symptoms at the onset of symptomatic illness, consideration should be given to including symptoms such as fatigue, headache, myalgia, nasal congestion and pharyngitis to the testing criteria. This research also shows the rate of symptom persistence, especially fatigue, smell disturbance and dyspnoea even after 6 months in this population of outpatients, 84% of whom did not have an inpatient stay during their illness.

This system and research have a number of shortcomings, however. The system was designed to maximise accessibility, utilising SMS as a notification method. We explored several initial IT designs (e.g. apps, chatbots, websites etc.) but opted for SMS to both maximise speed to implementation and accessibility (particularly amongst older and socially disadvantaged users). The symptom check-in tool link is included in typed format to allow those without smartphone internet access to complete the tool on another internet-connected device. However, the experience of clicking through the symptom check-in tool link does favour those with smartphone internet access. Both setups require a baseline level of technology literacy. The online system at present only exists in English and therefore may not be accessible to patients who don't speak English fluently. Similarly, the system may not be fully accessible to visually impaired patients and those with literacy issues. Further work is needed to provide similar levels of care to these vulnerable populations.

Though participation in the online COVID-19 symptom check-in was encouraging (72% of those contacted by text used the online check-in tool on at least one occasion), our results show that older patients, male patients and non-healthcare workers were statistically less likely to use this service. Future implementations of this tool will require design changes to increase user uptake in these categories.

Conclusion

In the era of COVID-19 and exponential growth in case numbers, an online symptom check-in service for outpatients with the disease was found to be acceptable to patients with high levels of engagement and satisfaction. It allowed for remote patient monitoring and triage of outpatients with COVID-19 disease. It provided links for patients to access official information on the disease and provided contact details for the in-house COVID-19 medical team if needed, and saw high levels of use among healthcare workers. This system also yielded interesting and valuable information on disease epidemiology among this cohort, highlighting the variety and persistence of symptoms experienced by patients with the disease during their acute illness and 6 months later. Additionally, this research showed that 8% of patients did not exhibit any of the cardinal symptoms associated with the disease during the first 7 days of their diagnosis. This point lends weight to the debate on RT-PCR screening among high risk populations and the expansion of test criteria during times of high prevalence.

Figure legends

Figure 1. Age categories of participants who were sent texts from the hospital (n=413), those who used the online COVID-19 symptom check-in tool (n=296), and those who participated in the feedback survey (n=140).

Figure 2. All reported symptoms and frequency over time (total responses to online check-in tool n=831).

Figure 3. All symptoms reported by individual participants during their acute illness (online check-in tool n=296) and 6 months later (feedback survey n=140).

Figure 4. Responses to feedback survey.

Figure 5. Words chosen by participants of the feedback survey to describe how receiving texts from the hospital for the online symptom check-in tool made them feel.

Figure 6. Feedback survey responses from those who completed the COVID-19 symptom check-in (n=108).

Figure 7. Participant feedback ratings.

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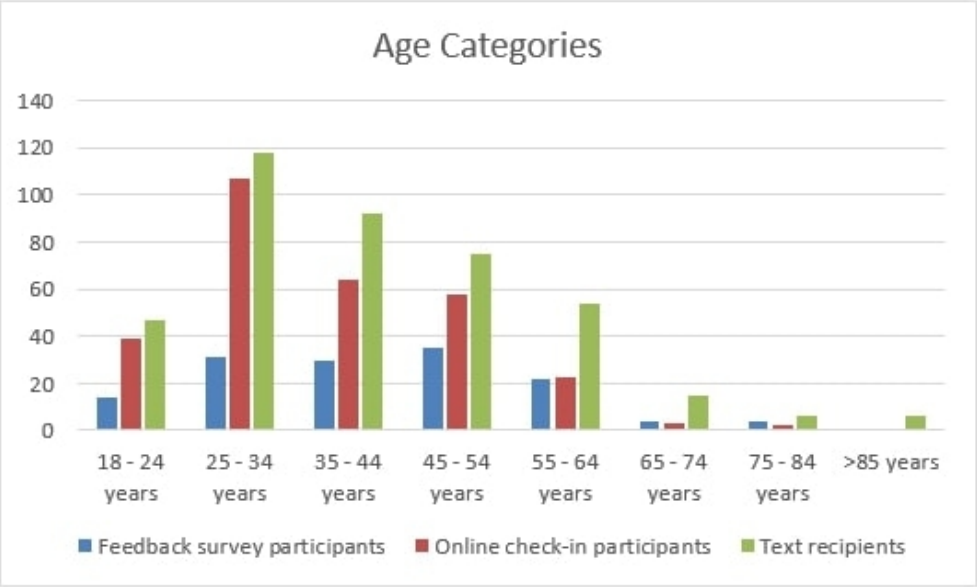

Figure 1

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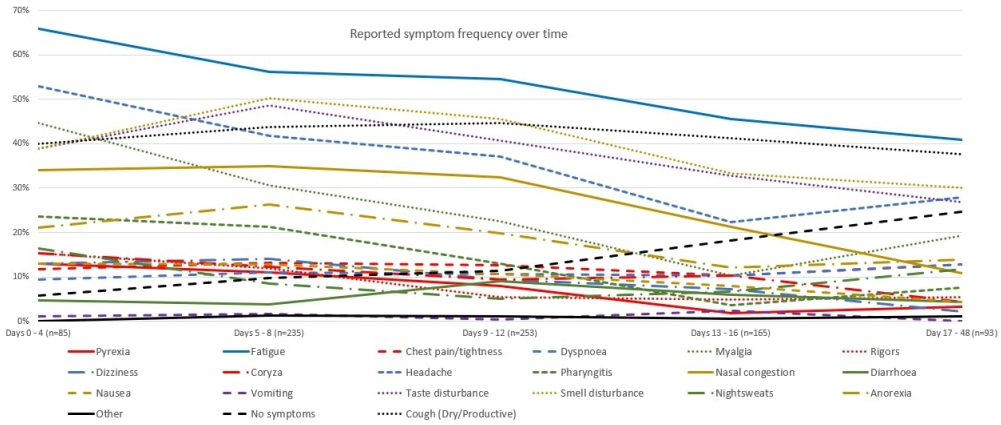

Figure 2

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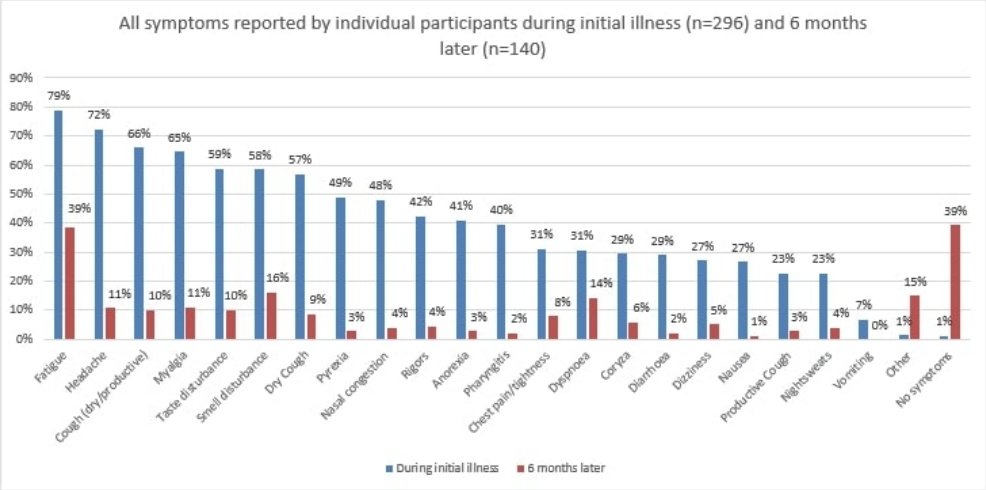

Figure 3

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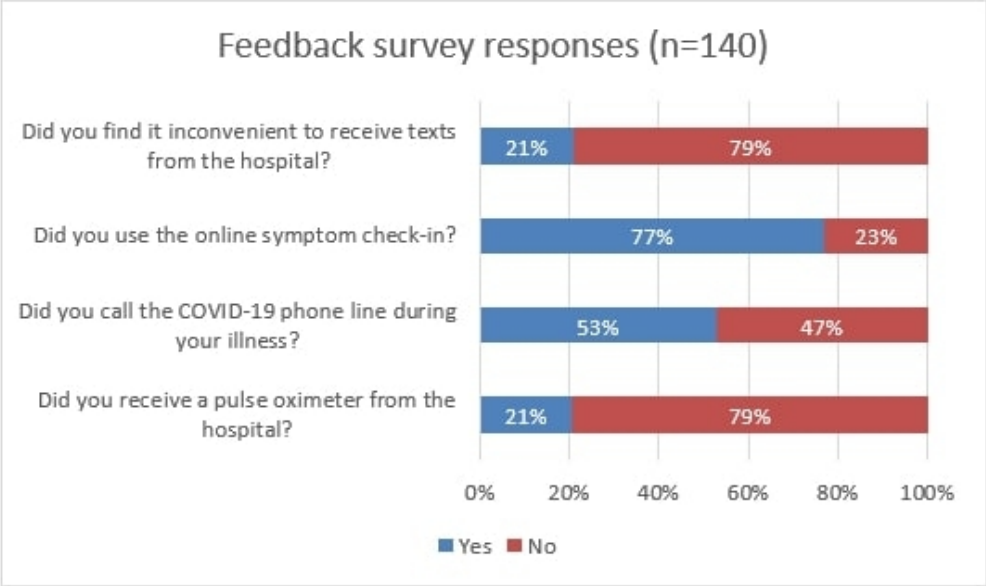

Figure 4

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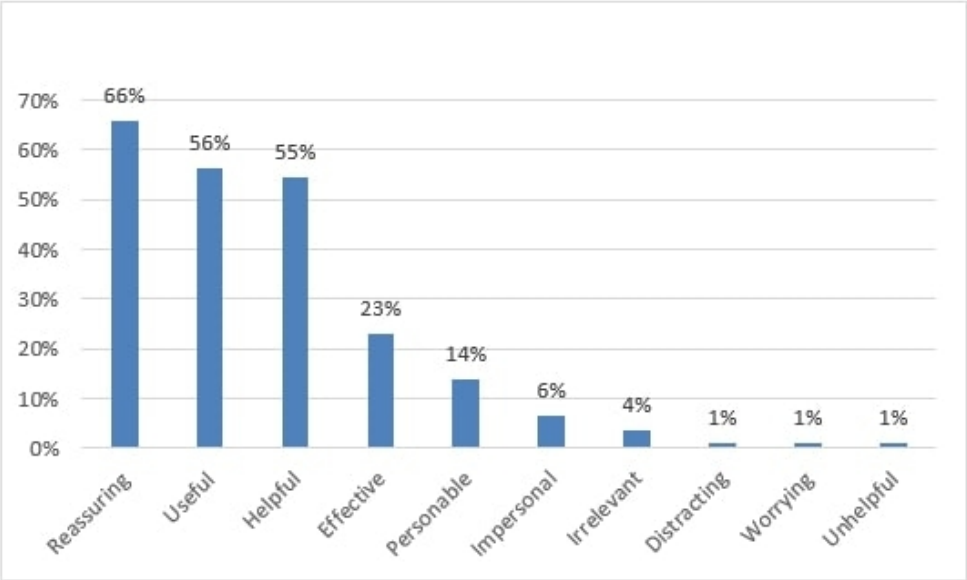

Figure 5

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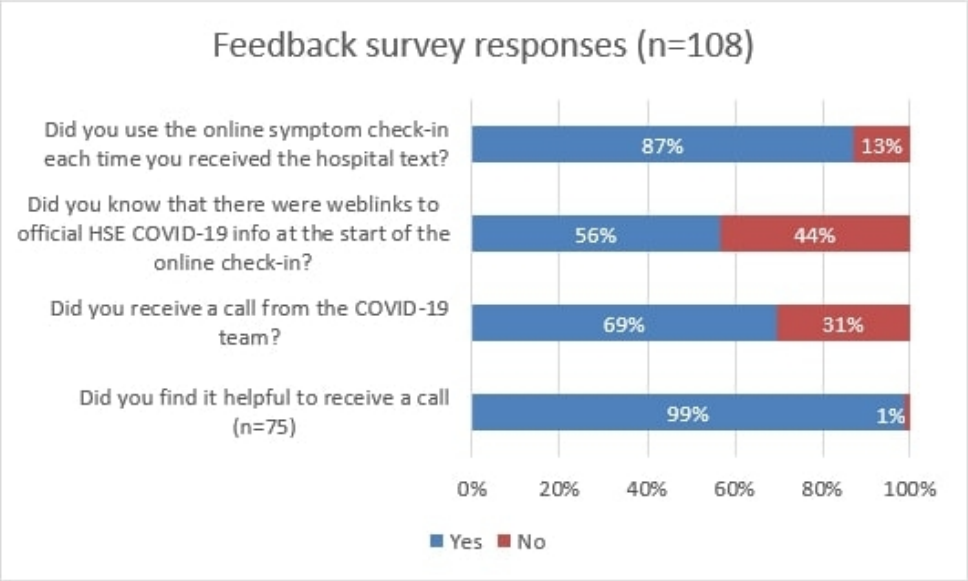

Figure 6

46x28mm (300 x 300 DPI)

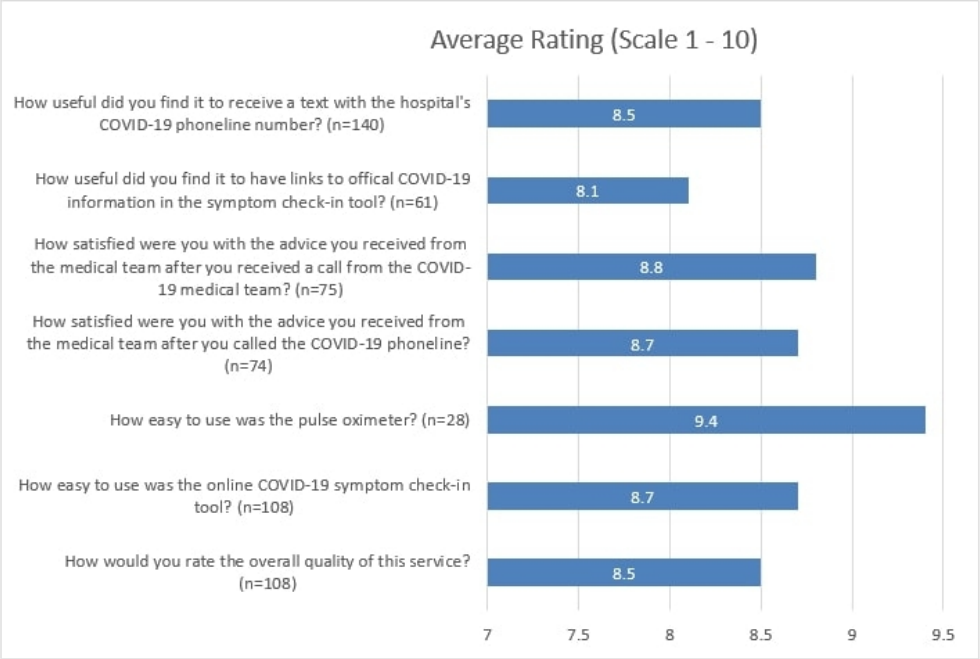

Figure 7

61x41mm (300 x 300 DPI)

Online symptom check-in tool – 13 questions

1. Can you please confirm your date of birth?
• [Free text]

2. Can you please confirm your initials?
• [Free text]

3. Can you please tell us on what date you first started to feel unwell? (When was the first day of your symptoms)?
• [Free text]

4. Can you please tell us which of the following symptoms you have had since you began to feel unwell? Please tick all that apply.
• Fever
• Tiredness
• Dry Cough
• Productive cough (with phlegm)
• Chest pain/tightness
• Shortness of breath
• Pains and aches
• Nausea
• Vomiting
• Change in your sense of taste
• Change in your sense of smell
• Night-sweats
• Loss of appetite
• Other (please specify)
• Chills
• Dizziness
• Runny nose
• Headache
• Sore throat
• Nasal congestion
• Diarrhoea

5. Do you have any of the following risk factors or medical conditions? Please tick all that apply.
• I have already had to stay overnight in a hospital because of COVID-19
• I am a Smoker
• I am an Ex-Smoker
• I have High Blood Pressure
• I have COPD/Emphysema/Bronchitis
• I have Asthma
• I have Diabetes
• I have Heart Disease (Angina, previous heart attacks, stents, heart bypass surgery, heart failure etc)
• I have other Endocrine conditions apart from Diabetes
• I have Chronic Kidney Disease
• I have Chronic Liver Disease

• I have Immunosuppression (from medications like chemotherapy or biological agents, or from conditions like HIV)
• I have a Blood Disorder (such as Leukaemia, Haemophilia or Sickle Cell etc.)
• I have an active Cancer diagnosis
• I have a Neurological condition (such as Epilepsy or Stroke)
• I don't have any of the above risk factors or medical conditions

6. Have you got a thermometer? if so, has your temperature gone above 38.5 degrees Celsius in the last 24 hours?
• I don't have a thermometer
• Yes, my temperature has gone above 38.5 degrees in the past 24 hours
• No, my temperature has not gone above 38.5 degrees in the past 24 hours

7. Have you got a blood oxygen monitor/pulse oximeter? if so, has your blood oxygen level dropped below 94% in the past 24 hours?

(If you have worsening shortness of breath and your oxygen monitor reads less than 94%, you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

• I don't have a blood oxygen monitor/pulse oximeter
• Yes, my blood oxygen levels have dropped below 94% in the past 24 hours
• No, my blood oxygen levels have not dropped below 94% in the past 24 hours

8. Are you so breathless that you are unable to speak more than a few words?

(If you have worsening shortness of breath and you have answered yes to the above question then you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

• Yes
• No

9. Are you breathing harder or faster than usual when doing nothing at all?
(If you have worsening shortness of breath and you have answered yes to the above question then you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

• Yes
• No

10. Are you so ill that you've stopped doing all of your usual daily activities?
• Yes
• No

11. Which symptoms have you got at the moment? Please tick all that apply or skip if you have no symptoms at the moment?
• Fever
• Tiredness
• Dry Cough
• Productive cough (with phlegm)

- Chest pain/tightness
- Shortness of breath
- Pains and aches
- Nausea
- Vomiting
- Change in your sense of taste
- Change in your sense of smell
- Night-sweats
- Loss of appetite
- Other (please specify)
- Chills
- Dizziness
- Runny nose
- Headache
- Sore throat
- Nasal congestion
- Diarrhoea

12. How are you feeling at the moment?

(If you feel much worse, then you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

- My symptoms have never been bad, and I feel well
- My symptoms have improved, and I feel better
- My symptoms have stayed the same and I feel the same
- My symptoms have worsened, and I feel a little worse
- My symptoms have worsened, and I feel much worse

13. Is there anything else that you feel the medical and nursing staff should be made aware of?
- [Free text]

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The acceptability of and symptom findings from an online symptom check-in tool for COVID-19 outpatient follow-up among a predominantly healthcare worker population.

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Competing Interest Statement

"All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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The subject matter of this paper was conceived by CK, SOR and CB, and designed by CK, SOR, GH, DC with oversight from UG and NN. Data was collected by CK, GH, DC, CC, MC, ZM and CM. CK, GH, DC, UG, NN and CB contributed to the editing of this paper. CK is the lead author and guarantor of this paper.

Transparency declaration

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Details of ethical approval

Full ethical approval was granted for this research by the St. James's Hospital and Tallaght University Hospital ethics committee on 31/3/20 (REC: 2020-03 Chairman's Action (16)).

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Data Sharing

All authors agree to sharing of the data contained in this research.

Abstract

Introduction

Health systems worldwide have had to prepare for a surge in volume in both the outpatient and inpatient settings since the emergence of COVID-19. International healthcare experiences show approximately 80% of patients classed as having mild disease can be managed as outpatients. However, SARS-CoV-2 can cause a biphasic illness. Those affected experience a clinical deterioration usually seen between day 4 and day 9 of their illness.

Objective

We created an online tool with the aim of allowing for virtual disease triage among the increasing number of outpatients diagnosed with COVID-19 by the hospital, to promote education and higher engagement with outpatients, and to gather information on patient symptomatology.

Methods

Outpatients with acute COVID-19 disease diagnosed at the hospital received text messages from the hospital containing a link to an online symptom check-in tool.

Results

296 unique participants (72%) from 413 contacted by text completed the online check-in at least once, generating 831 responses from 1324 texts sent. 7% of respondents admitted to slight worsening of their symptoms during follow up, but none declared a severe deterioration. Participants found the tool to be useful and easy to use, describing it as “helpful” and “reassuring” in a follow-up feedback survey (n=140). 93% said they would use such a tool in the future. Fatigue was the most common symptom reported (79%), followed by headache (72%) overall. Fatigue, headache and myalgia were the most frequently reported symptoms in the first 3 days of illness. 8% of participants did not report any of the cardinal symptoms (fever, cough, dyspnoea, taste/smell disturbance) in the first 7 days of their illness. 39% reported ongoing fatigue, 16% reported ongoing smell disturbance and 14% reported ongoing dyspnoea after 6 months.

Conclusion

This online symptom check-in tool was found to be acceptable to patients and saw high levels of engagement and satisfaction. The findings highlight the variety and persistence of symptoms experienced.

Strengths and Limitations

Strengths

- High level of uptake of the tool among those contacted (72%), resulting in over 800 responses from almost 300 unique individuals during the first wave of the COVID-19 pandemic in Ireland.
- This research also features a follow-up of this cohort at 6 months from their initial diagnosis

Weaknesses

- Tool requires smartphone internet access to complete the tool which may disadvantage older users.
- Requires a baseline level of technology literacy.
- The online system at present only exists in English.

Introduction

The COVID-19 pandemic poses a major obstacle to healthcare services across the globe. Originating in Wuhan, China, in late 2019 (1), the World Health Organisation declared the outbreak to be a Public Health Emergency of International Concern on January 30th 2020 (2) and a pandemic on March 11th 2020 (3). International healthcare experiences of COVID-19 infections show that approximately 20% of known patients with COVID-19 require inpatient admission (4-8). This in turn means that approximately 80% of patients' diagnoses are classed as having mild disease and can be managed as outpatients.

SARS-CoV-2 however can cause a biphasic illness in some patients (9). Those affected can experience a clinical deterioration usually seen between day 4 and day 9 of their illness and attributed to a form of cytokine storm (5, 10). This can result in a worsening of the disease course for community-based patients with COVID-19, initially having been well enough not to require inpatient care, leading to the need for clinical assessment and possible hospital admission. In particular, approximately 50% of patients with COVID-19 can develop shortness of breath or breathing difficulties (11) which can be indicative of more serious disease that may require hospitalisation.

Health systems worldwide have had to make preparations for a surge in volume in both the outpatient and inpatient settings since the emergence of COVID-19 (12). This increased demand on clinical capacity created several health system challenges as described and discussed by Judson et al. (13). Firstly, provision of care to the patients who needed it most was made more difficult by front-line clinicians and healthcare staff spending a large proportion of their time on triage. Secondly, a surge of patients attending urgent care and primary care practices for advice placed a further burden on healthcare systems as well as potentially impacting on infection control management. Thirdly, constantly changing information and guidelines placed a strain on maintaining consistency in terms of medical recommendations.

Our centre, St. James's Hospital, is a large teaching hospital and tertiary referral centre located in Dublin, Ireland. The first case of COVID-19 at St. James's Hospital was diagnosed in early March 2020. Initially, patients with a diagnosis of COVID-19 who were not deemed to require inpatient admission were "safety netted" on diagnosis and actively monitored via a telephone clinic operated by clinicians at St. James's Hospital. Patients received multiple phone calls over the course of their illness to assess the severity of their symptoms, and in the event of a worsening clinical picture, their need for hospital assessment and inpatient admission. However, with exponentially increasing numbers of new COVID-19 diagnoses by mid-March 2020, this strategy of active telemedicine follow up was no longer sustainable.

Aim

We created an online tool with the aim of allowing disease triage of outpatients diagnosed with COVID-19 at the hospital. This tool would also aim to promote patient education and engagement. The text and online tool would contain the phone number for the hospital's clinician-led COVID-19 phone line. Outpatients were prompted to contact this phone number if they had any clinical concerns related to their acute illness. Outpatients reporting worsening symptoms of clinical

concern would be triaged, identified, and contacted by the hospital's COVID-19 outpatient team. The tool also aimed to promote patient education by providing a weblink to national COVID-19 related health information sources that the patient could access if they so wished.

A secondary aim of this tool was to collect information on patient demographics and the range and duration of symptoms they experienced during the acute phase of their COVID-19 illness.

Methods

The online Typeform (™) platform was used to create a short online tool (COVID-19 symptom check-in tool) to provide information to and help triage outpatients with acute COVID-19 diagnosed at St. James's Hospital.

Patients or staff who received a diagnosis of PCR-proven COVID-19 at the hospital, or who received a PCR-proven diagnosis elsewhere but subsequently presented to the hospital, were included in this survey. The date of symptom onset for each patient with PCR proven COVID-19 disease was entered into their electronic patient record. Text messages were sent from the hospital to outpatients at day 3, day 6, day 9 and day 12 of their illness, covering the biphasic timeline of the illness in most cases. These dates were automatically calculated by using the patient's date of symptom onset, recorded on their electronic personal health record, as day 1. If an outpatient received a diagnosis of COVID-19 on the fourth day of their symptoms, the next text message they received would be on day 6, and they would receive just 3 messages in total. Only patients/staff with a valid mobile phone number in their electronic records were able to receive text messages. Patients/staff received texts depending on how far into their symptomatic illness they were, i.e., an outpatient who had PCR-proven COVID-19 detected 7 days into their symptoms received text messages at day 9 and day 12 only. The text contained a link to the online symptom check-in tool as well as a brief explanation of its purpose and the contact phone number for the dedicated clinician-led COVID-19 phone line that they could call if COVID-19 related advice was required. The questions in the tool were arrived at by clinician consensus and adapted from the publications below which became available during the design period.

The tool (supplementary material) consisted of 13 questions capturing basic patient information such as risk factors (adapted from Wu et al (14)), duration and nature of COVID-19 symptoms (adapted from Chen et al (15)), temperature and pulse oximetry (16) readings in the past 24 hours (if available), as well as an overall self-assessment of symptom progression since symptom onset. Two questions to assess the presence and severity of any breathing symptoms were adapted from the Greenhalgh et al. publication on remote clinical assessment of patients with COVID-19 (17). A short introductory and a conclusion page provided information on the hospital data privacy policy, a web link to the official national health service website for COVID-19 information (in multiple languages) as well as the contact phone number for the dedicated clinician-led COVID-19 phone line and the contact number for the emergency services should they be in extremis.

The text link to the online check-in tool was automatically sent to participants at 10:00 on the designated days. A clinician reviewed each response to the tool between 12:00 and 19:00 each day., Decisions to contact patients were made according to clinical acumen, considering the patient's reported symptoms, duration of illness, severity of symptoms and past medical history. The check-in tool prompted patients to enter their date of birth, initials, and date of symptom onset. If a response led to clinical suspicion of patient deterioration in the community, the patient could be identified by cross referencing the aforementioned identifiers with the hospital's electronic patient records, allowing them to be contacted and assessed by the clinician over the telephone. A decision could then be made to either reassure the patient and continue to monitor symptoms at home, link the patient in to further support services (home pulse oximetry), arrange a medical assessment at the hospital or advise to contact the emergency services and present immediately to the emergency department.

A follow-up survey was sent 6 months later to all recipients of the initial text messages to assess for feedback on their experience of the service. 6 months was chosen so as to allow sufficient time to elapse since the onset of the patients' symptoms and to allow adequate time for reflection on the service. These findings are included in this paper.

Patient and Public Involvement

Patients and the public were not involved in any way with the design of this research.

Results

In addition to testing of patients being transferred/presenting to the hospital, the hospital's occupational health department operated a busy COVID-19 swabbing hub for staff. Research by the PRECISE study group showed that 10.2% of the St. James's Hospital workforce had been diagnosed with COVID-19 by October 2020 (18) with the majority of infections occurring during the first wave of the pandemic from March to June 2020. There was an expectancy that healthcare professionals would be heavily represented in the online check-in respondents.

From April 2nd to June 7th, 1324 text messages were sent to 413 COVID-19 positive outpatients who had been diagnosed at St. James's Hospital, Dublin. These text messages led to 831 responses (62.8% response rate) on the online COVID-19 symptom check-in. The average age of the 413 text recipients was 41 years (median 39 years), with ages ranging from 19 – 99 years. 129 (31%) were male with 284 (69%) females. 342 (83%) were healthcare workers. 296 unique participants (72%) from the 413 contacted by text completed the online check-in at least once. The average age of these 296 patients was 37 years (median 35 years), with ages ranging from 19 – 81 years. 80 (27%) were male with 216 (73%) females. 269 of the respondents (91%) were healthcare workers.

Of the 117 (28%) who declined to respond to the online symptom check-in tool, the average age was 51 years (median age 51), with ages ranging from 21 – 99 years. 48 (41%) were male and 69 (59%) females. 76 (65%) were healthcare workers. Using Wilcoxon rank sum test (Mann-Whitney test), there was a statistically significant difference in the ages of participants who used the online symptom check-in tool versus those who didn't, with older patients less likely to participate than younger patients ($p < 0.01$). Using chi square testing, there was also a statistically significant difference among the genders ($p<0.01$) and healthcare worker status ($p<0.01$) in relation to their participation in the online symptom check-in tool with males and non-healthcare workers less likely to participate.

An anonymous feedback survey, to evaluate acceptability of the online check-in, was sent to the original 413 patients 6 months later in December 2020. This survey received 140 responses (34%). 32 (23%) were male and 108 (67%) were female. 116 (83%) were healthcare workers. The age categories of these participants were recorded and can be viewed in figure 1. 77% of these respondents (108/140) admitted to using the online check-in tool at least once between April and June 2020.

Online check-in tool

21 (7%) of online check-in participants had already spent at least one night in hospital due to COVID-19. 41 (17%) were current or ex-smokers. 59 (20%) didn't have access to thermometers and 225 (76%) had not been advised to use pulse oximeters at home. The comorbidities of the cohort are shown in table 1 below. Thirty-three (11%) of participants had a history of asthma or COPD, with 20 (7%) having hypertension and 11 (4%) having a diagnosis of diabetes (table 1). Table 1 also reveals that 56 (7%) of responses to the online check-in tool indicated a slight worsening of their symptoms during the course of their illness. 10 respondents (1%) reported shortness of breath at rest in addition to a slight worsening of their symptoms. No users of the tool declared a severe worsening

of their symptoms. 7 individual participants were identified by the COVID-19 outpatient team as requiring in-person medical assessment, and 3 were subsequently admitted to hospital.

Table 1. Demographics and comorbidities of those who participated in the online COVID-19 symptom check-in, as well as an overview of the 831 individual responses to the triage tool.

Online Check-in tool respondents	n (total n=296)	% of total respondents
Gender		
Male	80	27%
Female	216	73%
Age		
Average Age (IQR)	37 years (27 – 46 years)	Age Range: 19 – 81 years
Healthcare worker status		
Healthcare worker	269	91%
Non-Healthcare worker	27	9%
Smoking status		
Smoker	17	6%
Ex-smoker	34	11%
Never-smoker	245	83%
Symptom onset		
March 2020	100	34%
April 2020	164	55%
May 2020	32	11%
Already had an inpatient admission due to COVID-19	21	7%
Comorbidities		
COPD/Asthma	33	11%
Hypertension	20	7%
Diabetes mellitus	11	4%
Other endocrinopathies	9	3%
Ischaemic heart disease	4	1%
Immunosuppression	3	1%
Haematological disorder	2	1%
Active cancer diagnosis	2	1%
Neurological disorder	1	0%
Chronic kidney disease	1	0%
Chronic liver disease	0	0%
Individual responses	**n (total n=831)**	**% of total respondents**
My symptoms have never been bad	98	12%
My symptoms have improved	461	55%
My symptoms have stayed the same	216	26%
My symptoms have worsened a little	56	7%
My symptoms have worsened a lot	0	0%

Self-report of some tachypnoea/dyspnoea at rest	80	10%
Self-report of some tachypnoea/dyspnoea at rest and worsening/no improvement in symptoms	37	4%
Self-report of some tachypnoea/dyspnoea at rest and worsening of symptoms	10	1%

Table 2. Frequency of symptoms reported to the online check-in tool during the course of illness.

Symptom	Days 0 - 4 (n=85)	Days 5 - 8 (n=235)	Days 9 - 12 (n=253)	Days 13 - 16 (n=165)	Day 17 - 48 (n=93)
Fatigue	66%	56%	55%	45%	41%
Headache	53%	42%	37%	22%	28%
Myalgia	45%	31%	23%	10%	19%
Cough (Dry/Productive)	40%	44%	45%	41%	38%
Taste disturbance	39%	49%	41%	33%	27%
Smell disturbance	39%	50%	45%	33%	30%
Nasal congestion	34%	35%	32%	21%	11%
Dry Cough	29%	32%	31%	28%	32%
Pharyngitis	24%	21%	13%	4%	8%
Anorexia	21%	26%	20%	12%	14%
Night sweats	16%	9%	5%	7%	12%
Coryza	15%	12%	9%	10%	4%
Rigors	15%	12%	6%	5%	5%
Dizziness	13%	14%	9%	7%	2%
Nausea	13%	13%	11%	8%	4%
Pyrexia	13%	11%	8%	2%	3%
Productive Cough	12%	14%	17%	16%	5%
Chest pain/tightness	12%	13%	13%	10%	13%
Dyspnoea	9%	11%	11%	10%	13%
Diarrhoea	5%	4%	9%	6%	4%
Vomiting	1%	2%	0%	2%	0%
Other	0%	1%	1%	1%	1%
No symptoms	6%	10%	11%	18%	25%

Table 2 shows the symptoms reported by the responding participants at various time points. There were 831 responses in total to the online COVID symptom check-in, with 85 from participants from day 0-4 of their onset of symptoms, 235 responses during days 5-8, 253 responses during days 9-12, 165 responses during days 13-16 and 93 responses from patients from 17-48 days after the onset of their symptoms (though participants only received text messages with the link to the online check-in tool on days 3, 6, 9 and 12 of their symptoms, they could access the link again at any time, and several accessed the link between 17 and 48 days after the onset of their illness)

The clinical criteria for diagnosing COVID-19, according to the European Centre for Disease Prevention and Control (ECDC), include one or more of the following symptoms; cough, fever, shortness of breath, and sudden onset of taste and/or smell disturbance (19). In our population, fatigue (66%) was the most common symptom in the first 4 days of illness, followed by headache (53%) and myalgia (45%). The case criteria symptoms of cough (40%), taste disturbance (39%), smell disturbance (39%), pyrexia (13%) and shortness of breath were the 4th, 5th, 6th, 16th and 19th most frequently reported symptoms respectively during this period.

Most symptoms remained static or decreased in frequency over time with the exception of taste, smell disturbance and anorexia which peaked during days 5-8 of symptoms at 49%, 50% and 26% respectively. Only 25% of participants reported full resolution of their symptoms at 16 days or more post symptom onset.

Interestingly, 8% of responses (22/259) did not report any of the case defining criteria symptoms during their first 7 days of symptoms. 73% (16/22) of these participants reported fatigue, 55% (12/22) reported headache, 45% (10/22) reported myalgia, 41% (9/22) reported nasal congestion and 36% (8/22) reported pharyngitis. 86% (19/22) of these responses reported a combination of headache, pharyngitis, nasal congestion and coryzal symptoms.

Figure 2 shows the range and frequency of symptoms reported by participants during their initial illness between day 0 and day 48 (n=296) as well as the symptoms reported by participants of the feedback survey 6 months later (n=140). Fatigue was the most common symptom during the initial illness (79%), followed by headache (72%). The symptoms that meet the case definition criteria for COVID-19 (Cough, taste disturbance, smell disturbance, pyrexia and dyspnoea) were the 3rd, 5th, 6th 7th and 13th most frequent symptoms at 66%, 59%, 58%, 49% and 31% respectively. After 6 months, only 39% of participants reported being symptom free. 39% reported ongoing fatigue, 16% reported ongoing smell disturbance and 14% reported ongoing dyspnoea.

Feedback Survey:

140 participants responded to the feedback survey in December 2020. 79% (111) were third level educated (had attended university or college). 61% (86) were diagnosed with COVID-19 in April 2020, 31% (43) in March and 8% (11) in May. 16% (23) of respondents to this feedback survey were admitted to hospital for at least 24 hours during their initial acute illness.

Figure 3 shows that 79% (111) of participants did not feel inconvenienced by receiving text messages from the hospital, and 77% (108) used the online COVID symptom check in at least once. (Of the 29 participants who felt inconvenienced by the texts, 76% (22) used the online check-in tool at least once.) 53% (74) called the COVID-19 phone line during the course of their illness (this was the phone number contained in the text from the hospital and also highlighted in the online check-in tool). 21% (29) received a pulse oximeter from the hospital for remote SpO2 monitoring.

Participants who used the tool (n=108) were asked to choose as many words as applicable from the list in figure 4 to describe the effect that receiving texts from the hospital had on them. “Reassuring”, “useful” and “helpful” were selected in 66%, 56% and 55% of responses, with “distracting”, “worrying” and “unhelpful” each mentioned in 1% of responses (figure 4).

Of those who used the online symptom check-in (n=108), figure 5 shows that 87% (94) used it each time they received a text from the hospital. Only 56% (61) knew that the online symptom check in contained links to official Health Service Executive (Ireland's national public health service) COVID-19 information. The anonymous feedback survey also showed that 69% (75) of participants received a call from the COVID-19 team during the course of their illness. Of these participants (n=75), all but one participant found it helpful to receive such a call. Calls were made to "check-in" with patients if they complained of worsening symptoms or shortness of breath on the symptom check-in tool, and to assess their need for further clinical evaluation.

Participants were also asked to rate, on a scale of 1-10, how useful, easy to use and satisfied they were with different aspects of the service, along with their perception of the overall quality of the service (figure 6). On average, participants rated the usefulness of receiving a text with the COVID-19 phoneline number (n=140) and links to official COVID-19 info (n=61) at 8.5 and 8.1 respectively, their satisfaction with the advice they received on calling the phone line (n=74) at 8.7 and at 8.8 for those who received a call from the COVID team (n=75), and the ease of use of the pulse oximeter (n=28) and the online symptom checker (n=108) at 9.4 and 8.7 respectively. The quality of the service overall was rated as 8.5 (n=108). Of those who used the online symptom check-in (n=108), 93% (100/108) would use such a service again, with 3% saying they wouldn't and 4% saying they were unsure. Reasons given by those who didn't use the online symptom check-in (n=32) included feeling too unwell to use it (1/32), forgetting about it (5/32), feeling sufficiently informed by healthcare staff already (4/32) and feeling better and therefore not having a need to use it (5/32).

Discussion

Telehealth, defined as "electronic and telecommunications technologies and services used to provide care and services at a distance" (20), is an important frontline adjunct to traditional healthcare practices in helping to relieve pressure on health systems. Recent advances in telehealth have allowed telemedicine, the "practice of medicine using technology to deliver care at a distance", to be more widely exercised. Clinicians have used telehealth and telemedicine to adapt their services to the new challenges posed by the COVID-19 pandemic, such as remote patient management (21). There is a growing body of research demonstrating the important strategic role played by telehealth (through the use of telehealth apps and technologies such as wearables for SpO2 monitoring) in directly combating the pandemic itself, especially with regard to the 3 Ts; tracking, testing, and treating (22).

This online symptom check-in tool is a further application of telehealth, developed in the face of COVID-19, that was intended to serve several purposes. Firstly, the tool was created to serve as a triage device for the increasing number of people (predominantly healthcare workers) who received a diagnosis of COVID-19, a biphasic illness, at the hospital in whom an inpatient admission was not initially deemed necessary.

The tool also allowed for outpatients to be monitored remotely by the COVID medical team via their responses to the online symptom check-in tool. Clinicians could identify patients that required further clinical follow-up via the breadth and severity of symptoms, demographics, comorbidities, reported by the patient. Patients identified as having a need for further follow-up were contacted to assess their clinical needs. Such patients were either managed over the phone, offered home pulse oximetry monitoring, invited for in-hospital assessment or advised to present immediately to the emergency department, as appropriate. Our results show that a slight worsening of symptoms was reported in 7% of responses to the check-in tool, with 1% of respondents reporting a slight worsening of symptoms in the presence of dyspnoea at rest. No responses pertaining to more severe worsening of symptoms were recorded. The tool made available to outpatients the phone number of the dedicated, clinician-manned in-hospital COVID-19 patient advice phone that the patient was advised to call if they had any COVID-19 related concerns.

The tool helped to highlight to patients the red flag symptom of increasing breathlessness at rest associated with severe disease and prompted the patient to contact the hospital or emergency services in the event they experienced these symptoms. One reason, perhaps, why no participants reported a severe worsening of their symptoms could be because the check-in tool had prompted them to immediately call the COVID-19 patient advice phone at that point, though more research is required to further explore this theory. 7 check-in tool participants who reported slight worsening of their symptoms and/or shortness of breath at rest were identified by the clinicians staffing the dedicated COVID-19 patient advice phone and/or the online check-in tool as requiring in person medical assessment. 3 of these participants were subsequently admitted to hospital.

The tool provided a weblink to online, national COVID-19 related health information sources that the patient could access if they so wished, something which is ever more important in the era of social media disinformation and “Fake News” (23). This was intended to promote patient engagement and education on COVID-19. However, only 56% those who used the online check-in tool were aware of this weblink to official information, and though those who were aware of this link found it useful, giving it a rating of 8.1 out of 10 in terms of usefulness, more could be done to highlight this weblink in the future.

Overall, the system had high levels of engagement with a response rates of >60% to texts sent to patients and with 296 patients out of 413 contacted via text (72%) completing the online symptom check-in at least once during their illness. A large number of healthcare workers at the hospital were diagnosed with COVID-19 between March and June 2020 and this is reflected in the responses to the tool. The large proportion of females and third level educated participants also likely reflects the participation of healthcare workers. Participants found the service to be “useful” and “easy to use”, The programme intervention was well received with high levels of satisfaction both from those who called the COVID-19 phoneline for advice and telephone assessment and from those who received calls from the COVID-19 team for advice and telephone assessment after their online symptom

check-in responses were flagged. The overall quality of the service was found to be high among users and 93% said they would use such a service again in the future.

Another interesting outcome from this online symptom check-in tool relates to the findings in terms of frequency, range and time of onset of different symptoms among this cohort of COVID-19 positive patients. Headache, fatigue and myalgia were the most frequently reported symptoms in the initial days of illness, none of which currently belong to the case defining symptoms (fever, cough, dyspnoea, smell/taste disturbance) used by the ECDC (19). Fatigue and headache were reported more frequently overall than other symptoms. Two of the cardinal symptoms, taste and smell disturbance, appear to peak between days 5 and 8 post symptom onset. This could have a negative effect on disease spread if testing is delayed until these symptoms are experienced. A significant number of responses reported nasal congestion (~1/3) and pharyngitis (~1/4) in their initial days of illness. Almost 10% of patients did not experience any of the case defining criteria symptoms of COVID-19 in the first 7 days of their symptoms. These findings lend further weight to the case for screening people at high risk of COVID-19 disease in the absence of the current "case defining" symptoms. Given the prevalence of symptoms such as fatigue, headache, myalgia, nasal congestion and pharyngitis in our participants, especially in comparison to the cardinal symptoms at the onset of symptomatic illness, consideration should be given to adding these symptoms to the case defining criteria.

This research also shows the rate of symptom persistence, especially fatigue, smell disturbance and dyspnoea even after 6 months in this population of outpatients, 84% of whom did not have an inpatient stay during their illness. This finding chimes with other findings in the literature, where persistent anosmia (24) and post-viral fatigue have been seen commonly post COVID-19 infection, irrespective of severity of initial illness (25, 26). Further research is warranted to investigate the cause and progression of these persistent symptoms associated with post COVID syndrome.

This system and research have a number of shortcomings, however. Firstly, a significant majority of participants had third level (university/college) education (79% according to the anonymous feedback survey), and the overwhelming majority of users of the online check-in tool were healthcare workers, therefore the engagement with the tool and anonymous feedback received may not be as representative of that of a more general outpatient population. However, at the very least, the research shows the value of this tool to an occupational health population. The system was designed to maximise accessibility, utilising SMS as a notification method. We explored several initial IT designs (e.g., apps, chatbots, websites etc.) but opted for SMS to both maximise speed to implementation and accessibility (particularly amongst older and socially disadvantaged users). The symptom check-in tool link is included in typed format to allow those without smartphone internet access to complete the tool on another internet-connected device. However, the experience of clicking through the symptom check-in tool link does favour those with smartphone internet access. Both setups require a baseline level of technology literacy. The online system at present only exists in English and therefore may not be accessible to patients who don't speak English fluently. Similarly, the system may not be fully accessible to visually impaired patients and those with literacy issues. Further work is needed to provide similar levels of care to these vulnerable populations.

Though participation in the online COVID-19 symptom check-in was encouraging (72% of those contacted by text used the online check-in tool on at least one occasion), our results show that older patients, male patients and non-healthcare workers were statistically less likely to use this service. Future implementations of this tool will require design changes to increase user uptake in these categories.

Conclusion

In the era of COVID-19 and exponential growth in case numbers, an online symptom check-in service for outpatient triage was found to be acceptable to COVID-19 patients with high levels of engagement and satisfaction. It allowed for remote patient monitoring of outpatients with COVID-19 disease and provided links for patients to access official information on the disease and contact details for the in-house COVID-19 medical team if needed. It saw high levels of use among healthcare workers. This system also yielded interesting and valuable information on disease epidemiology among this cohort, highlighting the variety and persistence of symptoms experienced by patients with the disease during their acute illness and 6 months later. Additionally, this research showed that 8% of patients did not exhibit any of the cardinal symptoms associated with the disease during the first 7 days of their diagnosis. This point lends weight to the debate on RT-PCR screening among high-risk populations and the expansion of test criteria during times of high prevalence.

Figure legends

Figure 1. Age categories of participants who were sent texts from the hospital (n=413), those who used the online COVID-19 symptom check-in tool (n=296), and those who participated in the feedback survey (n=140).

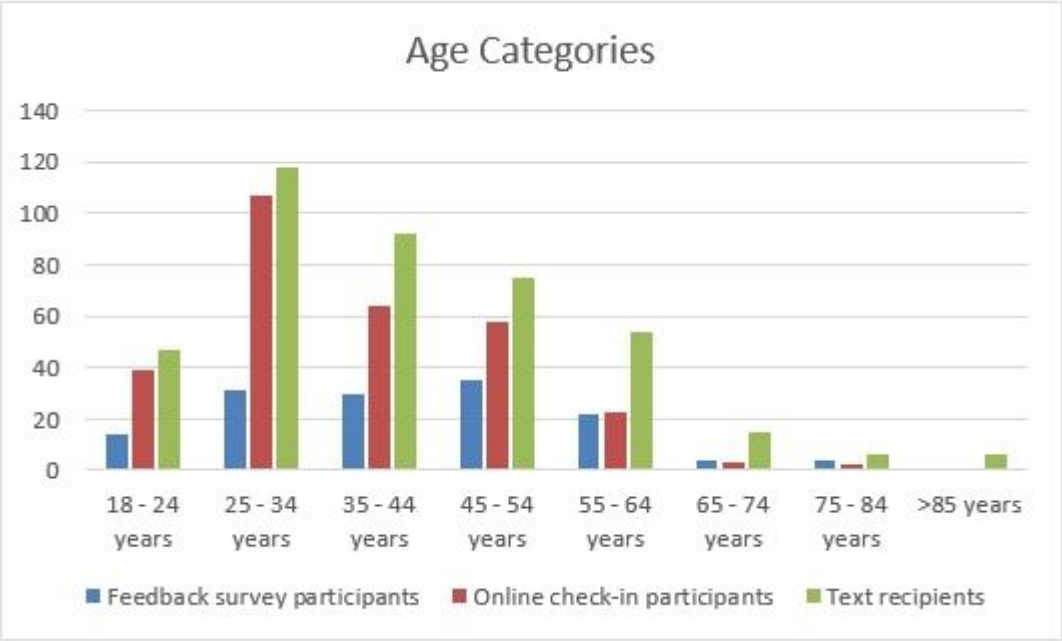
Figure 2. All symptoms reported by individual participants during their acute illness (online check-in tool n=296) and 6 months later (feedback survey n=140).

Figure 3. Responses to feedback survey.

Figure 4. Words chosen by participants of the feedback survey to describe how receiving texts from the hospital for the online symptom check-in tool made them feel.

Figure 5. Feedback survey responses from those who completed the COVID-19 symptom check-in (n=108).

Figure 6. Participant feedback ratings.



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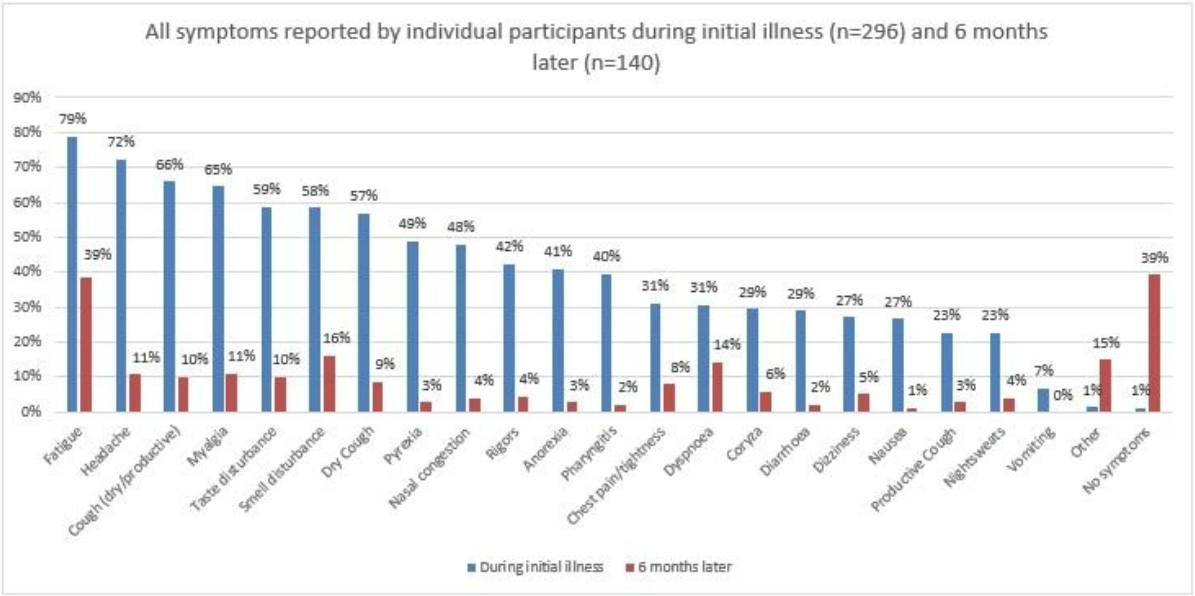

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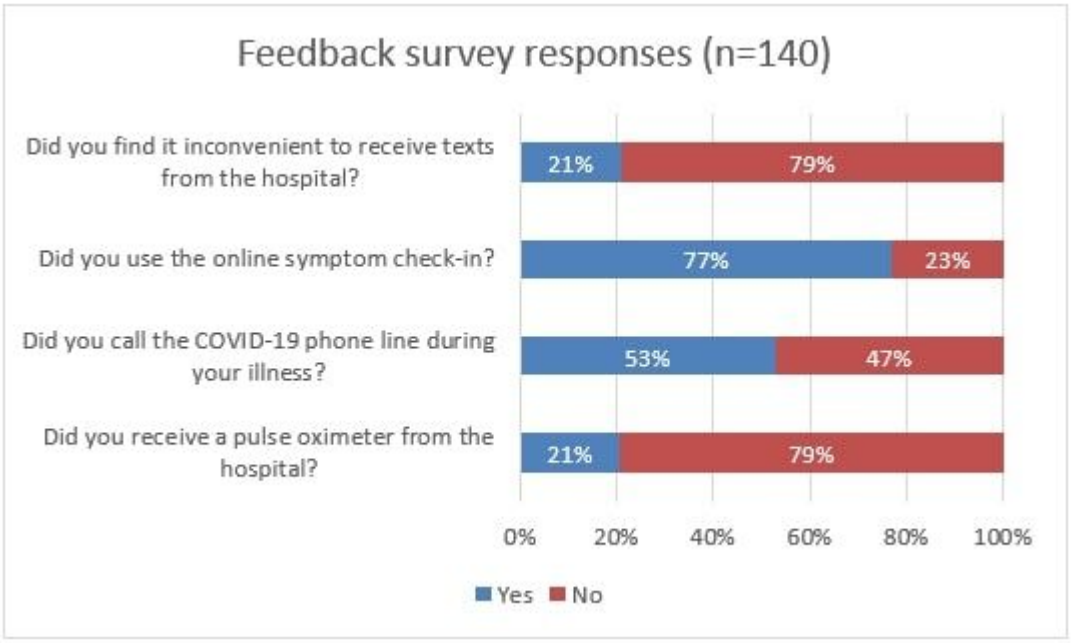

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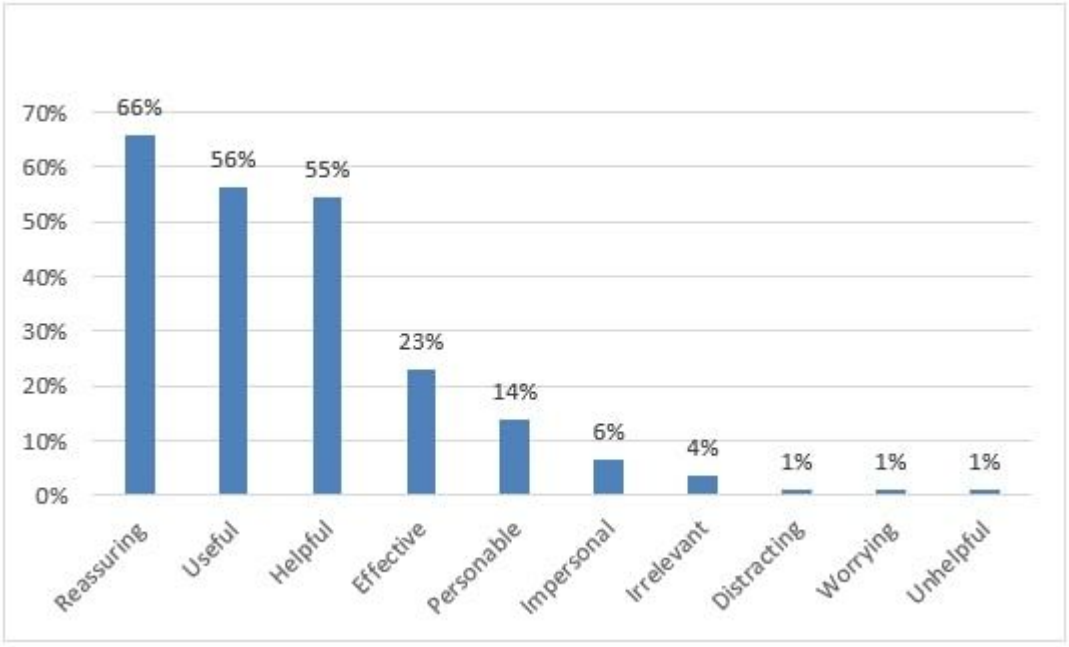

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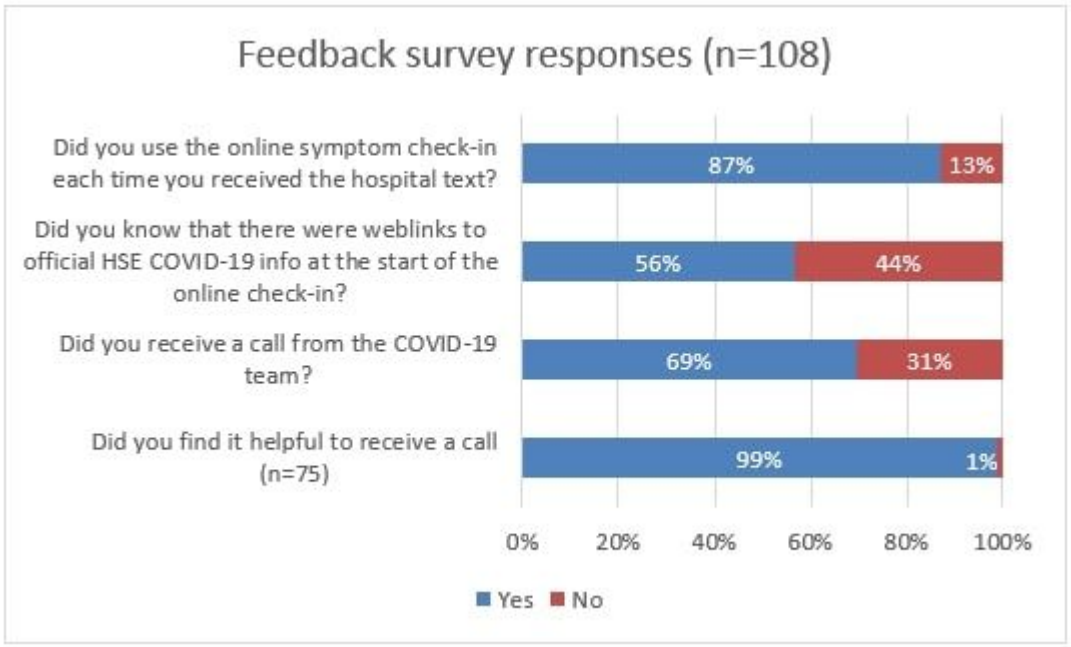

Figure 5. Feedback survey responses from those who completed the COVID-19 symptom check-in (n=108).

Figure 6. Participant feedback ratings.

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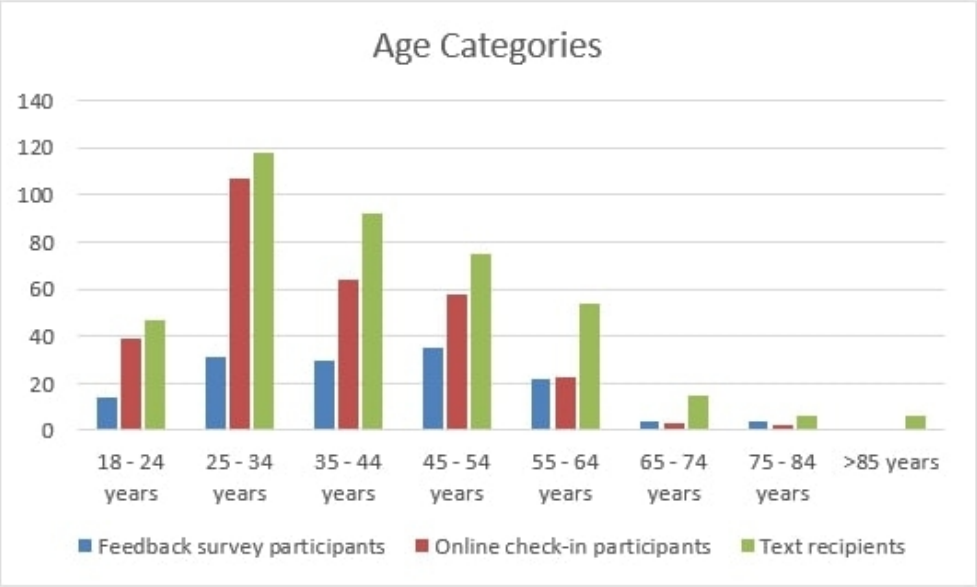

Figure 1

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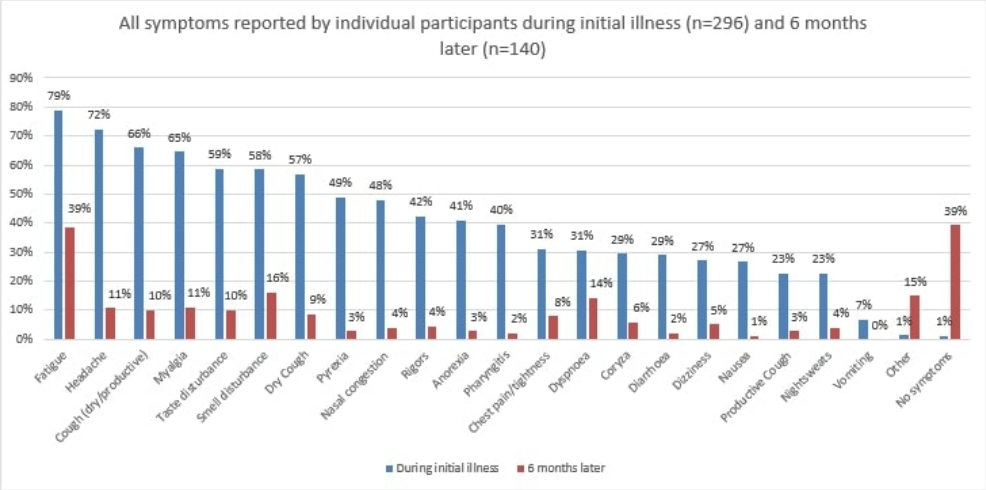

Figure 2

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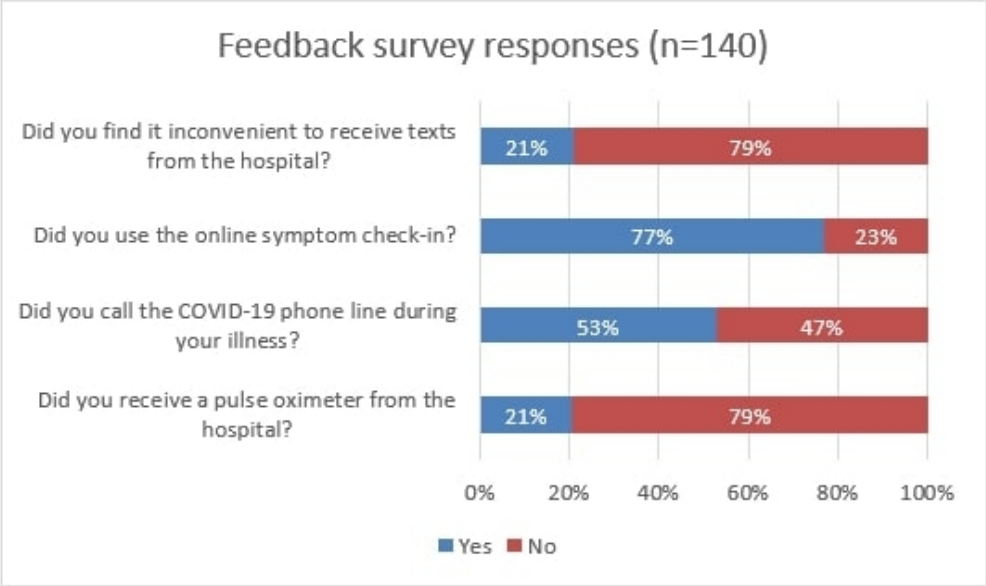

Figure 3

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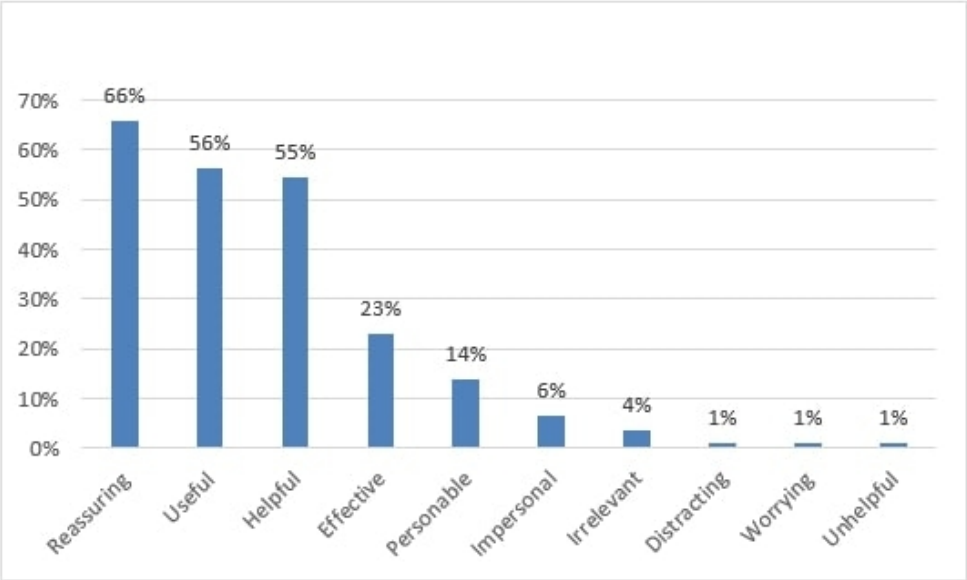

Figure 4

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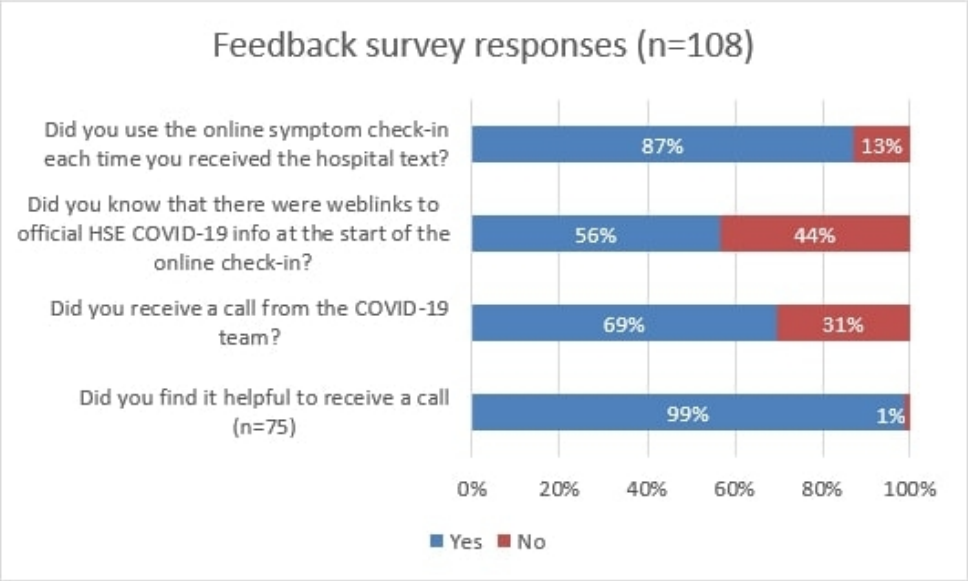

Figure 5

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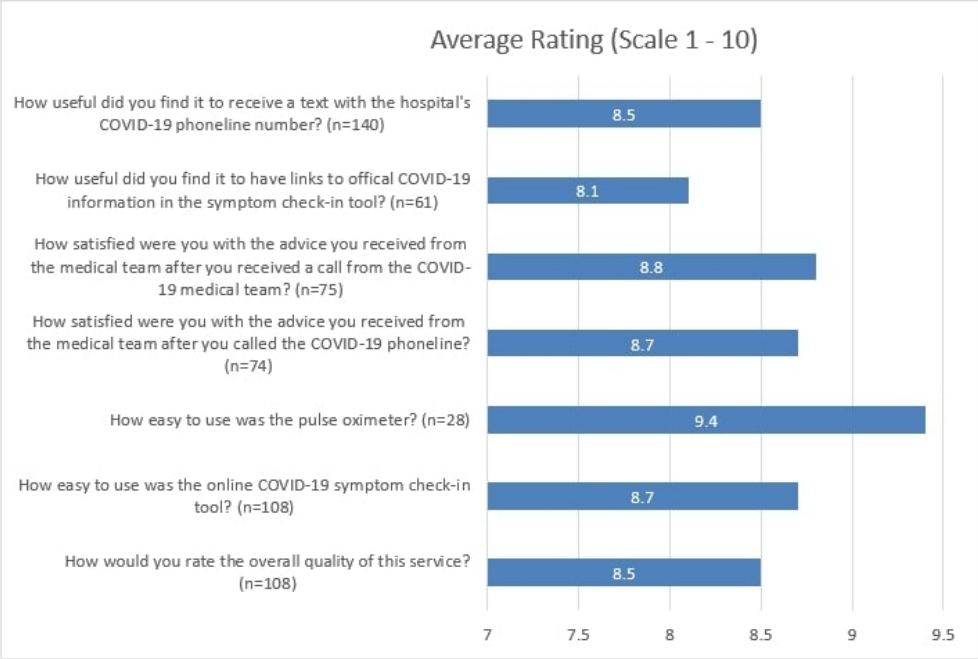

Figure 6

61x41mm (300 x 300 DPI)

Online symptom check-in tool – 13 questions

1. Can you please confirm your date of birth?
• [Free text]

2. Can you please confirm your initials?
• [Free text]

3. Can you please tell us on what date you first started to feel unwell? (When was the first day of your symptoms)?
• [Free text]

4. Can you please tell us which of the following symptoms you have had since you began to feel unwell? Please tick all that apply.
• Fever
• Tiredness
• Dry Cough
• Productive cough (with phlegm)
• Chest pain/tightness
• Shortness of breath
• Pains and aches
• Nausea
• Vomiting
• Change in your sense of taste
• Change in your sense of smell
• Night-sweats
• Loss of appetite
• Other (please specify)
• Chills
• Dizziness
• Runny nose
• Headache
• Sore throat
• Nasal congestion
• Diarrhoea

5. Do you have any of the following risk factors or medical conditions? Please tick all that apply.
• I have already had to stay overnight in a hospital because of COVID-19
• I am a Smoker
• I am an Ex-Smoker
• I have High Blood Pressure
• I have COPD/Emphysema/Bronchitis
• I have Asthma
• I have Diabetes
• I have Heart Disease (Angina, previous heart attacks, stents, heart bypass surgery, heart failure etc)
• I have other Endocrine conditions apart from Diabetes
• I have Chronic Kidney Disease
• I have Chronic Liver Disease

• I have Immunosuppression (from medications like chemotherapy or biological agents, or from conditions like HIV)
• I have a Blood Disorder (such as Leukaemia, Haemophilia or Sickle Cell etc.)
• I have an active Cancer diagnosis
• I have a Neurological condition (such as Epilepsy or Stroke)
• I don't have any of the above risk factors or medical conditions

6. Have you got a thermometer? if so, has your temperature gone above 38.5 degrees Celsius in the last 24 hours?
• I don't have a thermometer
• Yes, my temperature has gone above 38.5 degrees in the past 24 hours
• No, my temperature has not gone above 38.5 degrees in the past 24 hours

7. Have you got a blood oxygen monitor/pulse oximeter? if so, has your blood oxygen level dropped below 94% in the past 24 hours?

(If you have worsening shortness of breath and your oxygen monitor reads less than 94%, you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

• I don't have a blood oxygen monitor/pulse oximeter
• Yes, my blood oxygen levels have dropped below 94% in the past 24 hours
• No, my blood oxygen levels have not dropped below 94% in the past 24 hours

8. Are you so breathless that you are unable to speak more than a few words?

(If you have worsening shortness of breath and you have answered yes to the above question then you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

• Yes
• No

9. Are you breathing harder or faster than usual when doing nothing at all?
(If you have worsening shortness of breath and you have answered yes to the above question then you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

• Yes
• No

10. Are you so ill that you've stopped doing all of your usual daily activities?
• Yes
• No

11. Which symptoms have you got at the moment? Please tick all that apply or skip if you have no symptoms at the moment?
• Fever
• Tiredness
• Dry Cough
• Productive cough (with phlegm)

- Chest pain/tightness
- Shortness of breath
- Pains and aches
- Nausea
- Vomiting
- Change in your sense of taste
- Change in your sense of smell
- Night-sweats
- Loss of appetite
- Other (please specify)
- Chills
- Dizziness
- Runny nose
- Headache
- Sore throat
- Nasal congestion
- Diarrhoea

12. How are you feeling at the moment?

(If you feel much worse, then you should contact us on xxx xxxxxxx (between 9am & 6pm) or contact your local GP, Emergency Department or call 999)

- My symptoms have never been bad, and I feel well
- My symptoms have improved, and I feel better
- My symptoms have stayed the same and I feel the same
- My symptoms have worsened, and I feel a little worse
- My symptoms have worsened, and I feel much worse

13. Is there anything else that you feel the medical and nursing staff should be made aware of?
- [Free text]